Implementing a regional phenology network: the California Phenology Project

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UC Santa Barbara, National Park Service, USA National Phenology Network

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Scope of the California Phenology Project (CPP)

establish a coordinated phenological monitoring network, covering a large geographic area and sampling across key environmental gradients
Outline

• Intro to the USA-NPN phenology protocols
• Summary of CPP data
• Case studies:
  – Latitudinal gradient
  – Elevation gradient
  – Rainfall pulses
  – Continental extent
• Summary and next steps
• Intro to the USA-NPN phenology protocols
• Summary of CPP data
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  – Latitudinal gradient
  – Elevation gradient
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  – Continental extent
• Summary and next steps
### USA-NPN Protocols

#### Common Cowparsnip

**Species:** common cowparsnip  
**Nickname:** HELA2 (#64)

<table>
<thead>
<tr>
<th>Do you see...?</th>
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<tbody>
<tr>
<td>Initial growth</td>
<td>y</td>
<td>n</td>
<td>?</td>
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<tr>
<td>Leaves</td>
<td>y</td>
<td>n</td>
<td>?</td>
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<tr>
<td>Flowers or flower buds</td>
<td>y</td>
<td>n</td>
<td>?</td>
<td></td>
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<tr>
<td>Open flowers</td>
<td>y</td>
<td>n</td>
<td>?</td>
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<tr>
<td>Fruits</td>
<td>y</td>
<td>n</td>
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<tr>
<td>Ripe fruits</td>
<td>y</td>
<td>n</td>
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<tr>
<td>Recent fruit or seed drop</td>
<td>y</td>
<td>n</td>
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**Check when data entered online:**

#### California Live Oak

**Species:** California live oak  
**Nickname:** QUAG1 (#62)

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<th>Do you see...?</th>
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<tbody>
<tr>
<td>Breaking leaf buds</td>
<td>y</td>
<td>n</td>
<td>?</td>
<td></td>
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<tr>
<td>Young leaves</td>
<td>y</td>
<td>n</td>
<td>?</td>
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<tr>
<td>Flowers or flower buds</td>
<td>y</td>
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<tr>
<td>Open flowers</td>
<td>y</td>
<td>n</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>Pollen release</td>
<td>y</td>
<td>n</td>
<td>?</td>
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<tr>
<td>Fruits</td>
<td>y</td>
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<td>Ripe fruits</td>
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<td>Recent fruit or seed drop</td>
<td>y</td>
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**Check when data entered online:**
Phenophase Definitions

As you report on phenophase status (Y, N or ?) on the datasheets, refer to the definitions on this sheet to find out what you should look for, for each phenophase in each species. To report the intensity of the phenophase, choose the best answer to the question below the phenophase, if one is included. Feel free not to report on phenophases or intensity questions that seem too difficult or time-consuming.

**Leaves**

*Young leaves*

One or more young, unfolded leaves are visible on the plant. A leaf is considered “young” and “unfolded” once its entire length has emerged from the breaking bud so that the leaf stalk (petiole) or leaf base is visible at its point of attachment to the stem, but before the leaf has reached full size or turned the darker green color or tougher texture of mature leaves on the plant. Do not include fully dried or dead leaves.

**How many young leaves are present?**

*Less than 3*, 3 to 10, 11 to 100, 101 to 1,000, 1,001 to 10,000, More than 10,000.

**Flowers**

*Flowers or flower buds*

One or more fresh open or unopened flowers or flower buds are visible on the plant. Include flower buds that are still developing, but do not include wilted or dried flowers.

**How many flowers and flower buds are present?** For species in which individual flowers are clustered in flower heads, spikes or catkins (inflorescences), simply estimate the number of flower heads, spikes or catkins and not the number of individual flowers.

*Less than 3*, 3 to 10, 11 to 100, 101 to 1,000, 1,001 to 10,000, More than 10,000.

*Open flowers*

One or more open, fresh flowers are visible on the plant. Flowers are considered “open” when the reproductive parts (male stamens or female pistils) are visible between or within unfolded or open flower parts (petals, floral tubes or sepals). Do not include wilted or dried flowers.

**What percentage of all fresh flowers (buds plus unopened plus open) on the plant are open?** For species in which individual flowers are clustered in flower heads, spikes or catkins (inflorescences), estimate the percentage of all individual flowers that are open.

*Less than 5%, 5-24%, 25-49%, 50-74%, 75-94%, 95% or more.*

Pollen release

One or more flowers on the plant release visible pollen grains when gently shaken or blown into your palm or onto a dark surface.

**How much pollen is released?**

*Little: Only a few grains are released, Some: Many grains are released, Lots: A layer of pollen covers your palm, or a cloud of pollen can be seen in the air when the wind blows.*

**Fruits**

*Fruits*

One or more fruits are visible on the plant. For Baccharis pilularis, the fruit is very tiny and seed-like and is crowded into a small spent flower head. The seed-like fruit has a tuft of white hairs and changes from yellow-green to tan or light brown, and drops or is blown from the plant. Do not include empty flower heads that have already dropped all of their fruits.

**How many fruits are present?**

*Less than 3*, 3 to 10, 11 to 100, 101 to 1,000, 1,001 to 10,000, More than 10,000.

*Ripe fruits*

One or more ripe fruits are visible on the plant. For Baccharis pilularis, a fruit is considered ripe when it has turned tan or light brown, or when it readily drops or is blown from the spent flower head when touched. Do not include empty flower heads that have already dropped all of their fruits.

**What percentage of all fruits (unripe plus ripe) on the plant are ripe?**

*Less than 5%; 5-24% 25-49%; 50-74% 75-94% 95% or more.*

**Recent fruit or seed drop**

One or more mature fruits or seeds have dropped or been removed from the plant since your last visit. Do not include obviously immature fruits that have dropped before ripening, such as in a heavy rain or wind, or empty fruits that had long ago dropped all of their seeds but remained on the plant.

**How many mature fruits have dropped seeds or have completely dropped or been removed from the plant since your last visit?**

*Less than 3*, 3 to 10, 11 to 100, 101 to 1,000, 1,001 to 10,000, More than 10,000.
California Phenology Project: monitoring guide for Coyotebrush (Baccharis pilularis)

**CPP site(s) where this species is monitored**: Golden Gate National Recreation Area, Redwood National Park, Santa Monica Mountains National Recreation Area

**What does this species look like?**
This shrub can be up to three meters tall. The leaves are toothed, oval, and sticky. Coyotebrush is dioecious, meaning that each plant either produces flowers with only male parts or with only female parts. The male flowers produce yellow pollen and appear yellowish from a distance, and the female flowers produce fruit and are white. The flower heads appear round and disc-like.

When monitoring this species, use the USA-NPN broadleaf evergreen (with pollen, no leaf buds) trees and shrubs datasheet.

**Species facts!**
- The CPP four letter code for this species is BAPI.
- BAPI is a member of the sunflower family (Asteraceae).
- This species arises as a secondary pioneer species after fire or grazing.
- *Baccharis* derives from the Greek word “bakkaris”, referring to plants with fragrant roots, and *pilularis* refers to sticky globs on the flower buds.
- Native Americans used the heated leaves to reduce swelling, and the wood to make arrow shafts and houses.
- This species is an important nectar source for wasps, flies, and butterflies.

**Where is this species found?**
- Found in many habitats including coastal bluffs and oak woodlands.
- Found from 0 to 750 meters elevation, but occasionally up to 1500 meters.
- This species is occasionally found on serpentine soil.

For more information about phenology and the California Phenology Project (CPP), please visit the CPP website (www.usanpn.org/cpp) and the USA-NPN website (www.usanpn.org)
• Intro to the USA-NPN phenology protocols
• Summary of CPP data
• Species case studies:
  – Latitudinal gradient
  – Elevation gradient
  – Rainfall pulses
  – Continental extent
• Summary and next steps
Summary of the data

• 30 species
  – herbaceous perennials, evergreen shrubs and trees, deciduous shrubs and trees.
  – 8 are monitored in multiple parks.
• > 950 tagged monitored individuals
• > 22,000 observations
• > 160,000 observation records
• In 2011 accounted for 22% of USA-NPN database
Summary of the data

CPP observations 2011-2012

Observation records vs. Observation records (May-11 to Jul-12)

Observation records: 0 to 25000

Observation records (%) 0.00% to 100.00%

Month:
- Apr-11
- May-11
- Jun-11
- Jul-11
- Aug-11
- Sep-11
- Oct-11
- Nov-11
- Dec-11
- Jan-12
- Feb-12
- Mar-12
- Apr-12
- May-12
- Jun-12
- Jul-12
- More
Summary of the data

Proportion of observation records

Joshua Tree NP
Golden Gate NRA
Santa Monica NRA
Lassen Volcanic NP
Kings Canyon NP
Redwood NP
Outline

• Intro to the USA-NPN phenology protocols
• Summary of data: what we’ve collected so far
• Case studies:
  – Latitudinal gradient
  – Elevation gradient
  – Rainfall pulses
  – Continental extent
• Summary and next steps
Patterns across latitude

*Baccharis pilularis*

coyote brush

Redwood NP

Golden Gate NRA

Santa Monica Mountains NRA
Patterns across latitude

Baccharis pilularis

Proportion observations reporting flowers

Golden Gate NRA
Santa Monica Mountains NRA
Redwood NP

Golden Gate NRA
Santa Monica Mountains NRA
Redwood NP

REDW
GOGA
SAMO
Patterns across latitude

Baccharis pilularis

Proportion observations reporting flowers

Golden Gate NRA
Santa Monica Mountains NRA

6/6/11 7/26/11 9/14/11 11/3/11 12/23/11 2/11/12 4/1/12 5/21/12 7/10/12 8/29/12

10 day period

GOGA
SAMO

GOGA
SAMO

0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
1
2
3
4
5
6
7
8
9
10

Proportion observations reporting flowers

10 day period
Patterns across elevation

*Larrea tridentata*, Joshua Tree NP
Patterns across elevation

*Larrea tridentata*, Joshua Tree NP

Proportion of observations reporting flowering

10 Day Period

2011

2012
Larrea tridentata

Patterns across elevation

Proportion of observations reporting flowering

- 602 m
- 1180 m
- 1229 m
- 1340 m
- 1478 m
Response to precipitation

*Coleogyne ramosissima*
Response to precipitation

Coleogyne ramosissima

![Graph showing response to precipitation with Coleogyne ramosissima](image)

- **X-axis:** 10 day period
- **Y-axis, left side:** Proportion of observations with leaves
- **Y-axis, right side:** Precipitation (inches)

Legend:
- Red: Precipitation
- Blue: Proportion of plants with leaves
Response to precipitation

*Baccharis pilularis*, Golden Gate NRA

Proportion of observations reporting flowers

June 29 2011

Jan 21 2012

Mar 14 2012

Apr 11 2012

06/06/11 07/26/11 09/14/11 11/03/11 12/23/11 02/11/12 04/01/12 05/21/12 07/10/12

Proportion of observations reporting flowers

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
Continental patterns

*Populus tremuloides*
Continental patterns

Populus tremuloides leaf phenology

Proportion of observations reporting phenophase

Observation date

Phenophase category
Breaking leaf buds
Leaves
Colored Leaves

Intro to the USA-NPN phenology protocols

Summary of CPP data

Case studies:
- Latitudinal gradient
- Elevation gradient
- Rainfall pulses
- Continental extent

Summary and next steps
Summary

- One year of pilot data yields insights into phenological patterns and responses to environment
  - Latitude
  - Elevation
  - Precipitation pulses

- Challenges in identifying and characterizing phenological onset, peak and duration
Next steps

• Continue to collect data and expand network

• Use climate data (e.g., PRISM) to characterize variation between sites

• explore relative responsiveness of phenology to temperature and precipitation within populations and species.
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